FCC RADIO TEST REPORT

FCC ID	:	2AVBK-ATM210
Equipment	:	Object Detection Sensor
Brand Name	:	bitsensing
Model Name	:	ATM210
Applicant	:	bitsensing Inc. 165, Yeoksam-ro, Gangnam-gu, Seoul, Republic of Korea
Manufacturer	:	bitsensing Inc. 165, Yeoksam-ro, Gangnam-gu, Seoul, Republic of Korea
Standard	:	47 CFR FCC Part 15 Subpart C § 15.249

The product was received on Jan. 16, 2020, and testing was started from Feb. 04, 2020 and completed on Feb. 14, 2020. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013, 47 CFR FCC Part 15 Subpart C and shown compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issued Date
FR011613	01	Initial issue of report	Mar. 03, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
2.1	15.207	AC Power Line Conducted Emissions	PASS	-
2.2	15.249(a)	Field Strength of Fundamental Emissions	PASS	-
2.3	15.215(c)	20dB Spectrum Bandwidth	PASS	-
2.4	15.249(a)/(d)	Radiated Emissions	PASS	-
2.5	15.249(d)	Band Edge Emissions	PASS	-
2.6	15.203	Antenna Requirements	PASS	-

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
None

Reviewed by: Sam Chen

Report Producer: Viola Huang

1 General Information

1.1 Product Details

Items	Description
Power Type	From DC 12~24V
Modulation	FMCW
Frequency Range	24000 ~ 24250 MHz
Operation Frequency Range	24056.25 ~ 24243.75 MHz
Channel Bandwidth (99%)	188.42 MHz
Max. Field Strength	67.24 dBuV/m at 3m(Average) / 76.78 dBuV/m at 1m (Average)
Carrier Frequencies	Please refer to section 1.3
Accessories	N/A

Note: The above information was declared by manufacturer.

1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	bitsensing	Series-fed Patch Array Antenna	Series-fed Patch Array Antenna	N/A	14

Note: The above information was declared by manufacturer.

1.3 Table for Carrier Frequencies

Frequency Band	Frequency
24000 ~ 24250 MHz	24056.25 ~ 24243.75 MHz

1.4 Table for Test Modes

The following table is a list of the test modes shown in this test report.

Test Items	Mode	Frequency
AC Power Line Conducted Emissions	CTX	24056.25 ~ 24243.75 MHz
Field Strength of Fundamental Emissions 20dB Spectrum Bandwidth	CTX	24056.25 ~ 24243.75 MHz
Radiated Emissions 30MHz~1GHz	CTX	24056.25 ~ 24243.75 MHz
Radiated Emissions 1GHz~40GHz	CTX	24056.25 ~ 24243.75 MHz
Radiated Emissions 40GHz~100GHz	CTX	24056.25 ~ 24243.75 MHz
Band Edge Emissions	CTX	24056.25 ~ 24243.75 MHz

Note: CTX=continuously transmitting

The following test modes were performed for all tests:

For AC Power Line Conducted Emissions test:

Mode 1. EUT

For Radiated Emissions 30MHz~1GHz test:

The EUT was performed at X axis and Y axis position for Radiated emission above 1GHz test, and the worst case was found at X axis. So the measurement will follow this same test configuration.

Mode 1. EUT in X axis

For Radiated Emissions above 1GHz test:

The EUT was performed at X axis and Y axis position for test, and the worst case was found at X axis. So the measurement will follow this same test configuration.

Mode 1. EUT in X axis

1.5 Table for Testing Locations

Test Site Location					
Address:	No.8, Lane 724, Bo-ai St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C.				
TEL:	886-3-656-9065				
FAX:	886-3-656-9085				
Test Site No.	**Site Category**	**Location**	**FCC Designation No.**	**IC File No.**	**VCCI Reg. No**
03CH03-CB	SAC	Hsin Chu	TW0006	IC 4086D	-
03CH04-CB					
CO01-CB	Conduction	Hsin Chu	TW0006	IC 4086D	-
TH01-CB	OVEN Room	Hsin Chu	-	-	-

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC).

1.6 Table for Supporting Units

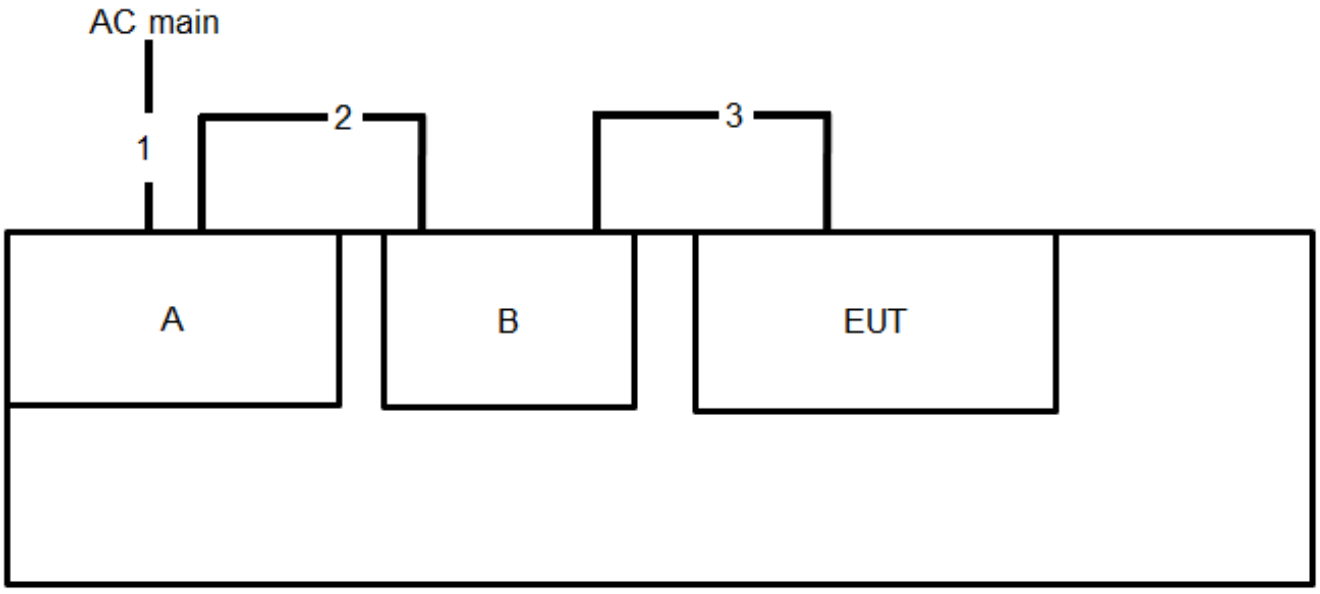
No.	Support Unit	Brand	Model	FCC ID
A	Power Supply	Advanced	LPS-305	N/A
B	Fixture Board	SMTECH	BTS-MSB-V01	N/A

1.7 Duty Cycle

On Time (ms)	On+Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)
0.080	19.360	0.41	23.84	12.50

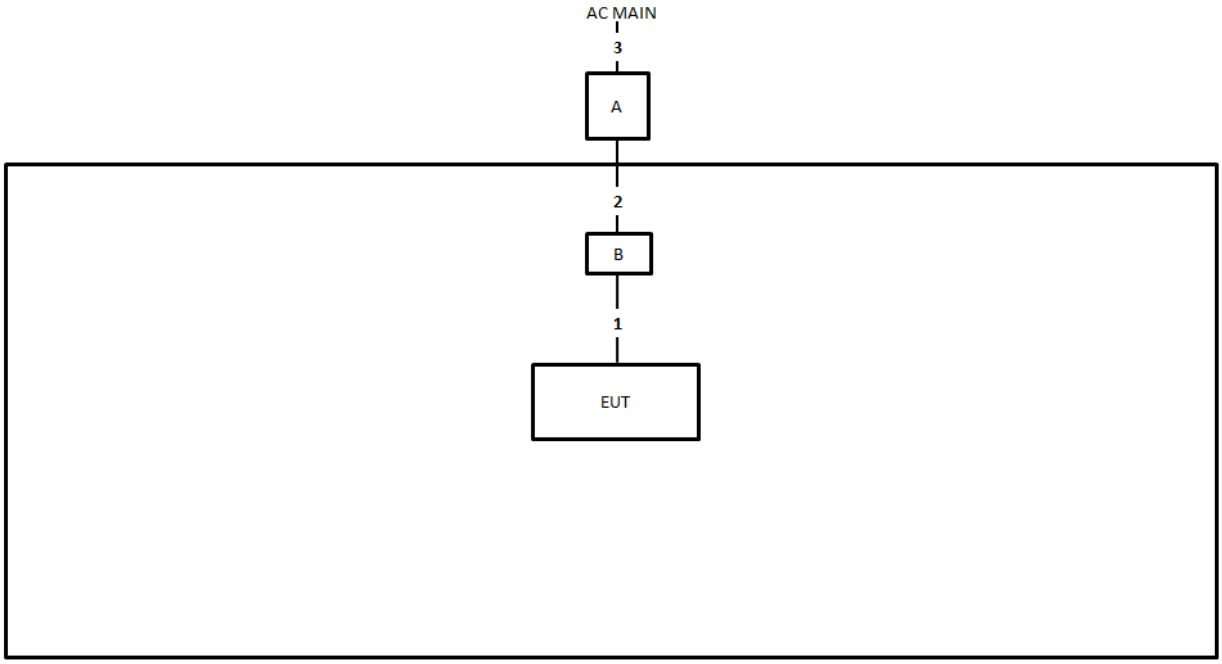
1.8 Test Configurations

1.8.1 AC Power Line Conduction Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	6.2m
2	Crocodile clip cable	No	1.5m
3	Power cable	No	1.5m

1.8.2 Radiation Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	6.2m
2	Crocodile clip cable	No	1.5m
3	Power cable	No	1.5m

2 Test Result

2.1 AC Power Line Conducted Emissions Measurement

2.1.1 Limit

For this product which is designed to be connected to the AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed below limits table.

Frequency (MHz)	QP Limit (dBuV)	AV Limit (dBuV)
0.15~0.5	66~56	56~46
0.5~5	56	46
5~30	60	50

2.1.2 Measuring Instruments and Setting

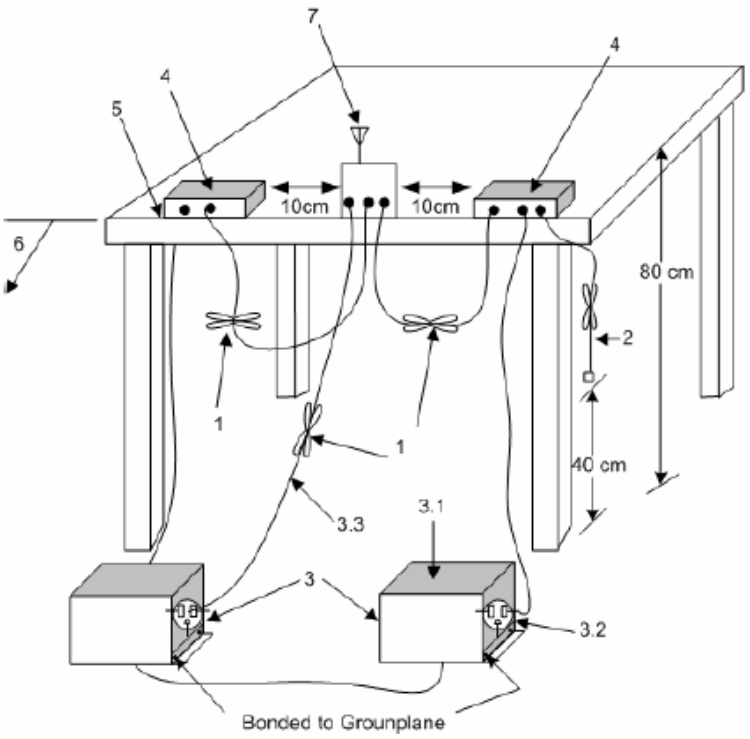
Refer a test equipment and calibration data table in this test report. The following table is the setting of the receiver.

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

2.1.3 Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 kHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.

2.1.4 Test Setup Layout



1—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long.
2—The I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
3—EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN may be placed on top of, or immediately beneath, reference ground plane.
3.1—All other equipment powered from additional LISN(s).
3.2—A multiple-outlet strip may be used for multiple power cords of non-EUT equipment.
3.3—LISN at least 80 cm from nearest part of EUT chassis.
4—Non-EUT components of EUT system being tested.
5—Rear of EUT, including peripherals, shall all be aligned and flush with edge of tabletop.
6—Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.
7—Antenna can be integral or detachable. If detachable, then the antenna shall be attached for this test.

2.1.5 Test Deviation

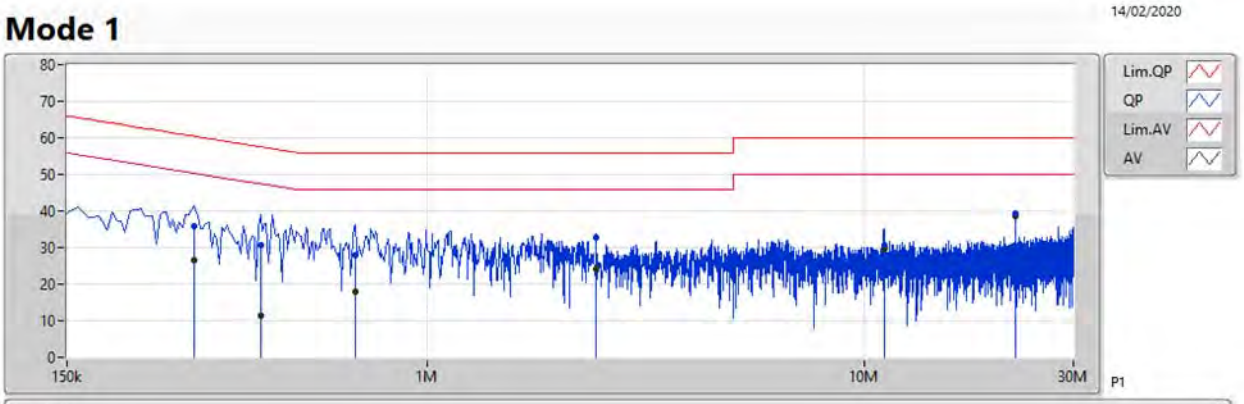
There is no deviation with the original standard.

2.1.6 EUT Operation during Test

The EUT was placed on the test table and programmed in normal function.

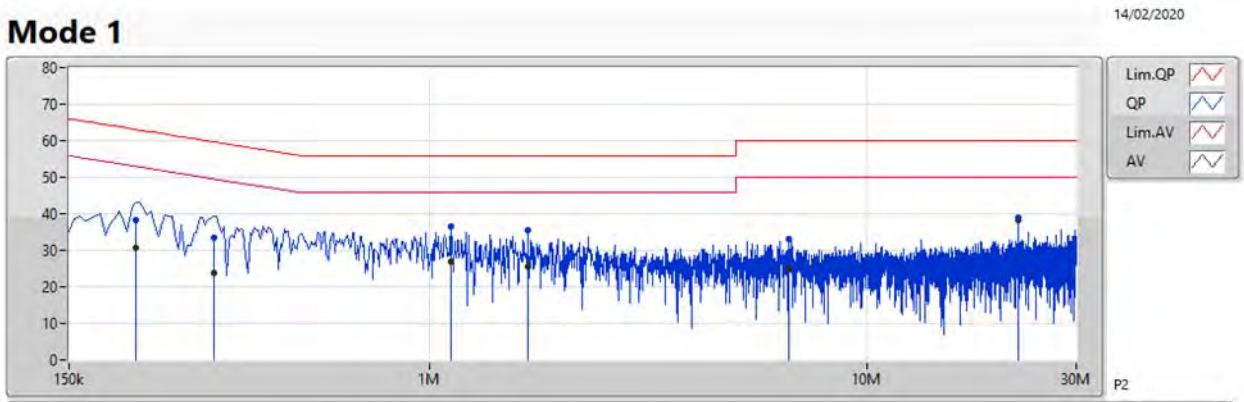
2.1.7 Results of AC Power Line Conducted Emissions Measurement

Temperature	24.3~25℃	Humidity	60~63%
Test Engineer	Wei Li	Phase	Line
Configuration	CTX		



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	AF	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	294k	35.77	60.42	-24.65	9.91	Line	-	25.86	0.05	0.06	9.80
AV	294k	26.52	50.42	-23.90	9.91	Line	-	16.61	0.05	0.06	9.80
QP	415.5k	30.70	57.53	-26.83	9.92	Line	-	20.78	0.05	0.06	9.81
AV	415.5k	11.35	47.53	-36.18	9.92	Line	-	1.43	0.05	0.06	9.81
QP	685.5k	27.76	56.00	-28.24	9.96	Line	-	17.80	0.06	0.08	9.82
AV	685.5k	18.07	46.00	-27.93	9.96	Line	-	8.11	0.06	0.08	9.82
QP	2.432M	32.87	56.00	-23.13	10.05	Line	-	22.82	0.10	0.13	9.82
AV	2.432M	24.02	46.00	-21.98	10.05	Line	-	13.97	0.10	0.13	9.82
QP	11.063M	30.67	60.00	-29.33	10.40	Line	-	20.27	0.25	0.23	9.92
AV	11.063M	29.51	50.00	-20.49	10.40	Line	-	19.11	0.25	0.23	9.92
QP	22.119M	39.20	60.00	-20.80	10.76	Line	-	28.44	0.46	0.30	10.00
AV	22.119M	38.71	50.00	-11.29	10.76	Line	"Worst"	27.95	0.46	0.30	10.00

Temperature	24.3~25℃	Humidity	60~63%
Test Engineer	Wei Li	Phase	Neutral
Configuration	CTX		



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	AF	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	213k	38.38	63.09	-24.71	9.90	Neutral	-	28.48	0.05	0.06	9.79
AV	213k	30.63	53.09	-22.46	9.90	Neutral	-	20.73	0.05	0.06	9.79
QP	321k	33.42	59.67	-26.25	9.91	Neutral	-	23.51	0.05	0.06	9.80
AV	321k	23.67	49.67	-26.00	9.91	Neutral	-	13.76	0.05	0.06	9.80
QP	1.118M	36.45	56.00	-19.55	9.97	Neutral	-	26.48	0.06	0.09	9.82
AV	1.118M	26.86	46.00	-19.14	9.97	Neutral	-	16.89	0.06	0.09	9.82
QP	1.68M	35.46	56.00	-20.54	10.01	Neutral	-	25.45	0.07	0.11	9.83
AV	1.68M	25.64	46.00	-20.36	10.01	Neutral	-	15.63	0.07	0.11	9.83
QP	6.603M	33.27	60.00	-26.73	10.22	Neutral	-	23.05	0.15	0.20	9.87
AV	6.603M	24.75	50.00	-25.25	10.22	Neutral	-	14.53	0.15	0.20	9.87
QP	22.119M	38.88	60.00	-21.12	10.59	Neutral	-	28.29	0.29	0.30	10.00
AV	22.119M	38.44	50.00	-11.56	10.59	Neutral	"Worst"	27.85	0.29	0.30	10.00

Note:

Level = Read Level + LISN Factor + Cable Loss

2.2 Field Strength of Fundamental Emissions Measurement

2.2.1 Limit

The field strength of fundamental emissions within these bands specified at a distance of 3 meters (measurement instrumentation employing an average detector) shall comply with the following table.

Frequency Band	Fundamental Emissions Limit Average/Peak (dBuV/m) at 3m
24000 ~ 24250 MHz	107.96/127.96

Note 1: 107.96 dBuV/m rounding to 108dBuV/m and 127.96 dBuV/m rounding to 128dBuV/m

Note 2: Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [1m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [9.54 dB].

Average limit = 108dBuV/m + distance extrapolation factor (9.54 dB) =117.54dBuV/m.

Peak limit = 128dBuV/m + distance extrapolation factor (9.54 dB) =137.54dBuV/m.

2.2.2 Measuring Instruments and Setting

Refer a test equipment and calibration data table in this test report. The following table is the setting of the spectrum analyzer.

Power Meter Parameter	Setting
RBW	1 MHz Peak / 3MHz Average
VBW	1 MHz Peak / 1/T Average
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

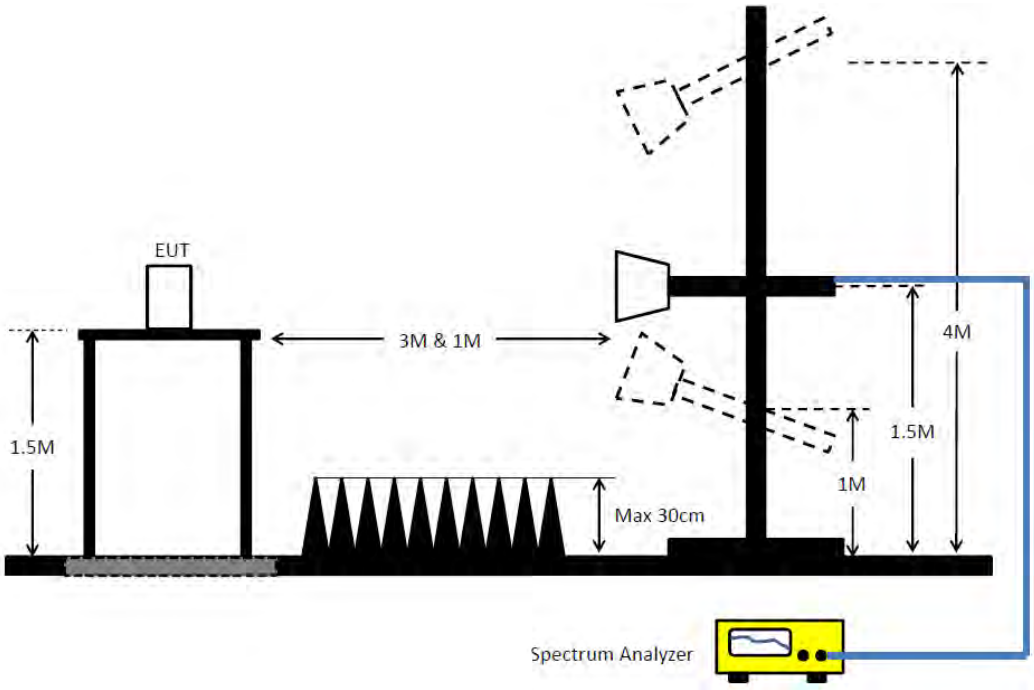
2.2.3 Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. For Fundamental emissions, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW

and 1/T VBW for average reading in spectrum analyzer.

6. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

2.2.4 Test Setup Layout



2.2.5 Test Deviation

There is no deviation with the original standard.

2.2.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.2.7 Test Result of Field Strength of Fundamental Emissions

Temperature	19~20.6℃	Humidity	64~67%
Test Engineer	KJ Chang	Test Date	Feb. 04, 2020 ~ Feb. 07, 2020

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	23958.00	20.75	63.54	-42.79	3.65	15.99	38.92	37.81	153	10	Average	HORIZONTAL
2	23958.00	68.43	83.54	-15.11	51.33	15.99	38.92	37.81	153	10	Peak	HORIZONTAL
3	24178.80	50.62	117.54	-66.92	33.72	16.09	38.86	38.05	153	10	Average	HORIZONTAL
4	24178.80	98.30	137.54	-39.24	81.40	16.09	38.86	38.05	153	10	Peak	HORIZONTAL
5	24476.40	20.06	63.54	-43.48	3.34	16.22	38.80	38.30	153	10	Average	HORIZONTAL
6	24476.40	67.74	83.54	-15.80	51.02	16.22	38.80	38.30	153	10	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	23972.40	20.20	63.54	-43.34	3.15	15.99	38.91	37.85	153	3	Average	VERTICAL
2	23972.40	67.88	83.54	-15.66	50.83	15.99	38.91	37.85	153	3	Peak	VERTICAL
3	24177.20	76.78	117.54	-40.76	59.86	16.08	38.87	38.03	153	3	Average	VERTICAL
4	24177.20	124.46	137.54	-13.08	107.54	16.08	38.87	38.03	153	3	Peak	VERTICAL
5	24257.20	20.14	63.54	-43.40	3.29	16.12	38.85	38.12	153	3	Average	VERTICAL
6	24257.20	67.84	83.54	-15.70	50.99	16.12	38.85	38.12	153	3	Peak	VERTICAL

Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

2.3 20dB Spectrum Bandwidth Measurement

2.3.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band (24000 ~ 24250 MHz).

2.3.2 Measuring Instruments and Setting

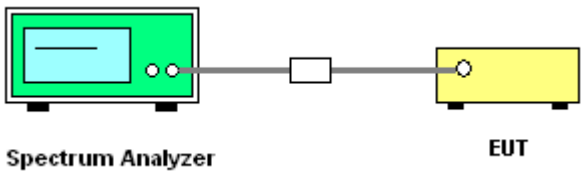
Refer a test equipment and calibration data table in this test report. The following table is the setting of the spectrum analyzer.

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> 20dB Bandwidth
RBW	100 kHz
VBW	100 kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

2.3.3 Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth of 100 kHz and the video bandwidth of 100 kHz were used.
3. Measured the spectrum width with power higher than 20dB below carrier.

2.3.4 Test Setup Layout



2.3.5 Test Deviation

There is no deviation with the original standard.

2.3.6 EUT Operation during Test

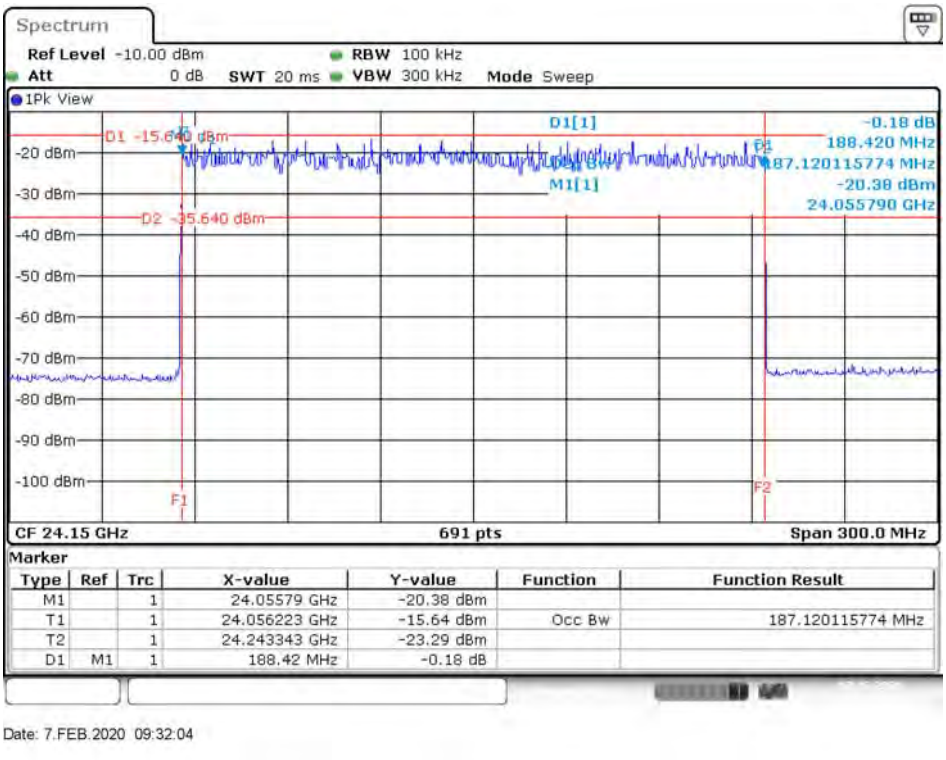
The EUT was programmed to be in continuously transmitting mode.

2.3.7 Test Result of 20dB Spectrum Bandwidth

Temperature	19.9~20.6℃	Humidity	64~65%
Test Engineer	Eddie Weng		

Frequency	20dB BW (MHz)	99% OBW (MHz)	Frequency range (MHz) f_L > 24000MHz	Frequency range (MHz) f_H < 24250MHz	Test Result
24056.25 ~ 24243.75 MHz	187.12	188.42	24055.7900	-	PASS
			-	-	PASS
			-	24243.3430	PASS

20 dB + 99% Bandwidth Plot on 24056.25 ~ 24243.75 MHz



2.4 Radiated Emissions Measurement

2.4.1 Limit

For 9kHz~40GHz

Harmonic emissions limits comply with below 54 dBuV/m at 3m. Other emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

For 40GHz~100GHz

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 47 CFR Part 15.249, whichever is the lesser attenuation.

Operating Frequencies	Harmonics Strength (micorvolts/meter)	Harmonics Strength (dBuV/m) at 3m
24000 ~ 24250 MHz	2500 at 3m	68 (Average)
24000 ~ 24250 MHz	2500 at 3m	88 (Peak)

2.4.2 Measuring Instruments and Setting

Refer a test equipment and calibration data table in this test report. The following table is the setting of the spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RBW / VBW	1MHz / 1MHz for Peak, 1 MHz / 1/T for Average

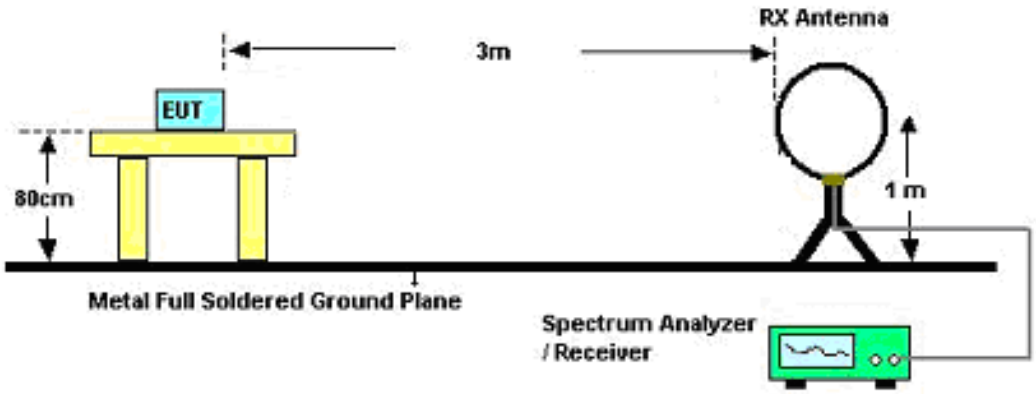
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RBW 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RBW 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RBW 120kHz for QP

2.4.3 Test Procedures

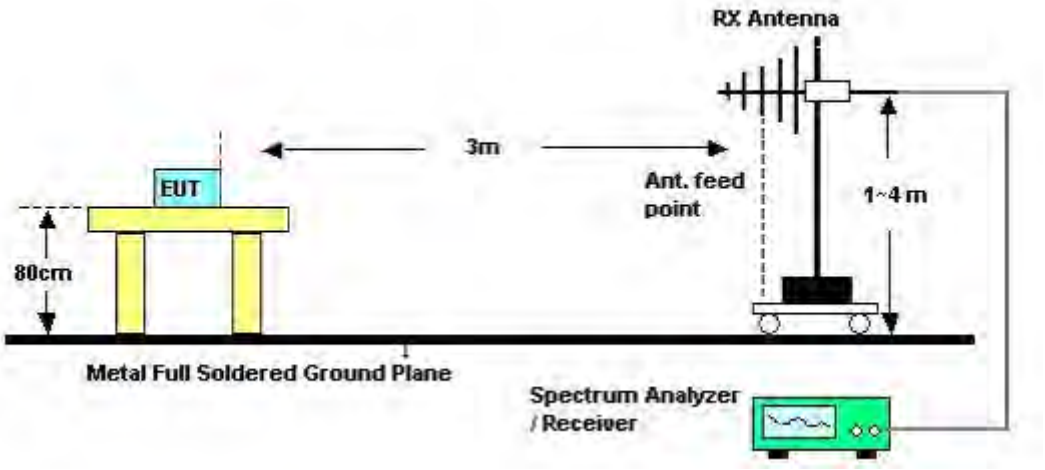
1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 1/T VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

2.4.4 Test Setup Layout

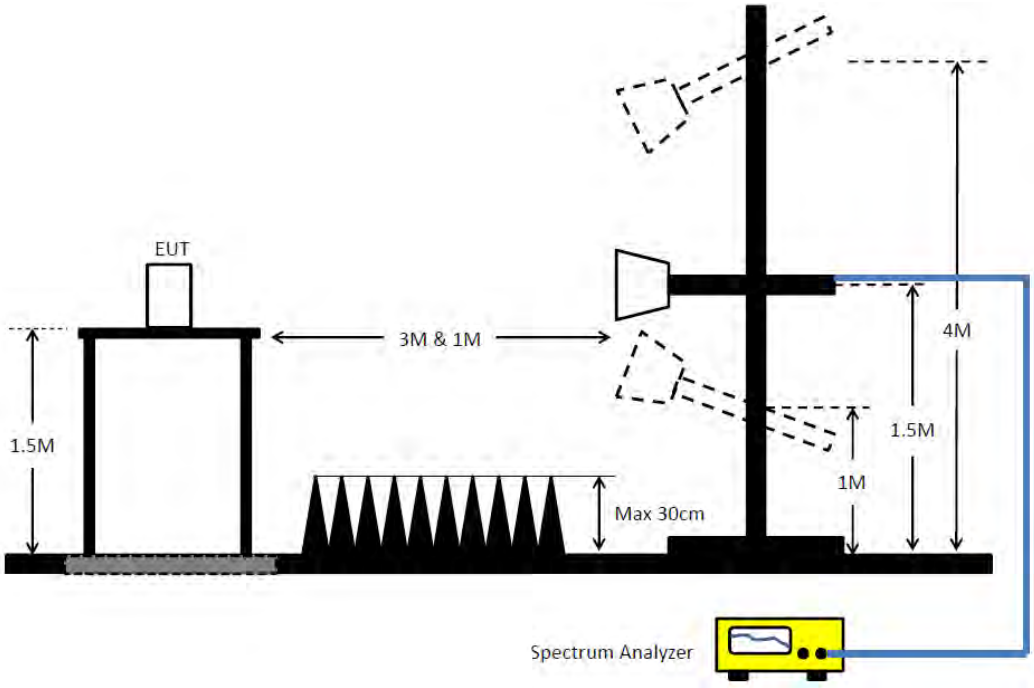
For Radiated Emissions: 9kHz ~30MHz



For Radiated Emissions: 30MHz~1GHz



For radiated emissions: 1GHz~40GHz

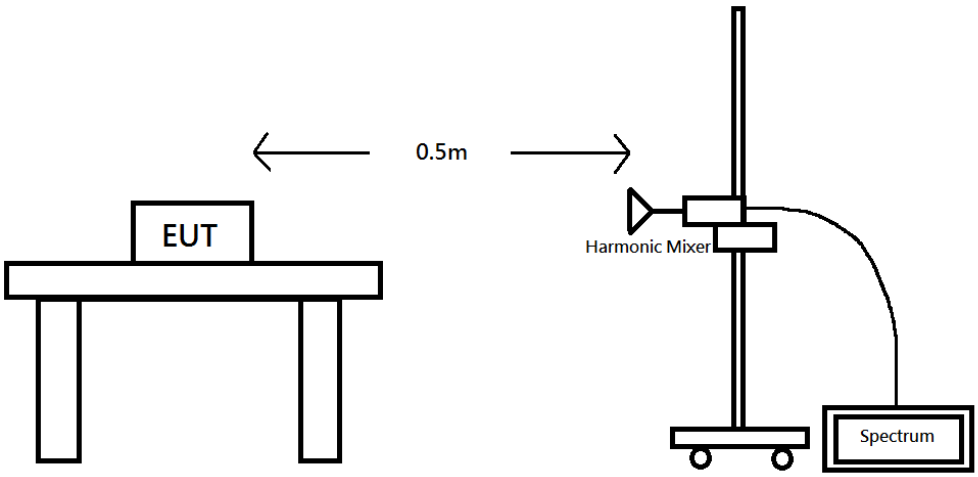


Above 10 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [1m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [9.54 dB].

For radiated emissions: 40GHz~100GHz



2.4.5 Test Deviation

There is no deviation with the original standard.

2.4.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.4.7 Results of Radiated Emissions (9kHz~30MHz)

Temperature	19~20.6℃	**Humidity**	64~67%
Test Engineer	KJ Chang	**Configurations**	CTX
Test Date	Feb. 04, 2020 ~ Feb. 07, 2020		

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
-	-	-	-	See Note

Note:

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to KDB414788 Radiated Test Site, and the result came out very similar.

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

The radiated emissions were investigated from 9 kHz or the lowest frequency generated within the device, up to the 10 harmonic or 40 GHz, whichever is appropriate.

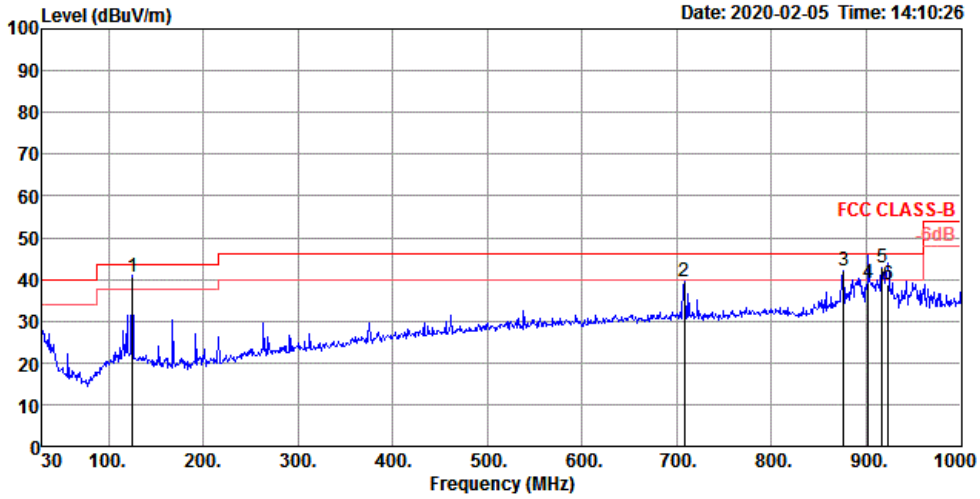
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

2.4.8 Results of Radiated Emissions (30MHz~1GHz)

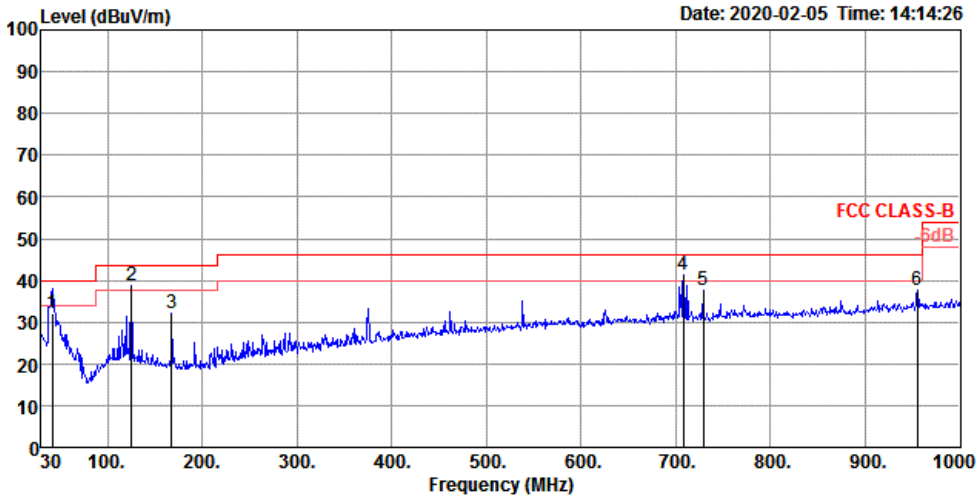
Temperature	19~20.6℃	**Humidity**	64~67%
Test Engineer	KJ Chang	**Configurations**	CTX

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	125.06	40.45	43.50	-3.05	53.30	1.33	17.94	32.12	300	88	QP	HORIZONTAL
2	708.03	39.55	46.00	-6.45	42.69	3.22	25.57	31.93	100	225	Peak	HORIZONTAL
3	875.84	42.03	46.00	-3.97	43.41	3.55	26.49	31.42	100	2	Peak	HORIZONTAL
4	902.03	39.10	46.00	-6.90	40.00	3.61	26.69	31.20	100	349	QP	HORIZONTAL
5	916.58	42.91	46.00	-3.09	43.56	3.67	26.75	31.07	100	11	Peak	HORIZONTAL
6	923.37	38.67	46.00	-7.33	39.20	3.69	26.78	31.00	100	359	QP	HORIZONTAL

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	41.64	32.17	40.00	-7.83	46.10	0.80	17.49	32.22	100	305	QP	VERTICAL
2	125.06	38.57	43.50	-4.93	51.42	1.33	17.94	32.12	100	207	Peak	VERTICAL
3	167.74	32.16	43.50	-11.34	46.93	1.54	15.75	32.06	125	213	Peak	VERTICAL
4	708.03	41.40	46.00	-4.60	44.54	3.22	25.57	31.93	125	127	Peak	VERTICAL
5	729.37	37.65	46.00	-8.35	40.75	3.26	25.66	32.02	125	156	Peak	VERTICAL
6	955.38	37.55	46.00	-8.45	37.49	3.80	26.95	30.69	200	329	Peak	VERTICAL

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

2.4.9 Results for Radiated Emissions (1GHz~40GHz)

Temperature	19~20.6℃	Humidity	64~67%
Test Engineer	KJ Chang	Configurations	1~18G
Test Date	Feb. 04, 2020 ~ Feb. 07, 2020		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1599.93	44.20	54.00	-9.80	49.96	3.70	25.10	34.56	188	51	Average	HORIZONTAL
2	1600.06	51.12	74.00	-22.88	56.88	3.70	25.10	34.56	188	51	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1599.92	39.09	54.00	-14.91	44.85	3.70	25.10	34.56	132	71	Average	VERTICAL
2	1599.92	44.56	74.00	-29.44	50.32	3.70	25.10	34.56	132	71	Peak	VERTICAL

Temperature	19~20.6℃	Humidity	64~67%
Test Engineer	KJ Chang	Configurations	18~40G
Test Date	Feb. 04, 2020 ~ Feb. 07, 2020		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	20160.00	10.56	63.54	-52.98	-10.50	14.57	37.96	31.47	157	326	Average	HORIZONTAL
2	20160.00	58.24	83.54	-25.30	37.18	14.57	37.96	31.47	157	326	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	20160.00	15.45	63.54	-48.09	-5.61	14.57	37.96	31.47	157	112	Average	VERTICAL
2	20160.00	63.13	83.54	-20.41	42.07	14.57	37.96	31.47	157	112	Peak	VERTICAL

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

2.4.10 Results for Radiated Emissions (40GHz~100GHz)

Temperature	19.9~20.6℃	**Humidity**	64~65%
Test Engineer	KJ Chang	**Configurations**	40~100G
Test Date	Feb. 04, 2020 ~ Feb. 07, 2020		

Frequency (GHz)	Measurement Distance (m)	Measurement Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
48.113	0.5	85.846	103.52	-17.674
Frequency (GHz)	**Measurement Distance (m)**	**Measurement Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**
48.113	0.5	74.856	83.52	-8.664

Distance extrapolation factor = 20 log (specific distance [3m] / test distance [0.5m]) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [15.56 dB].

EIRP = PT * GT = (PR / GR) * (4 * Pi * D / λ)^2

EIRP = Meas. Level - RX Antenna Gain + 20*log(4*Pi(3.14159)*D/(300/(Frequency*1000)))

2.5 Band Edge Emissions Measurement

2.5.1 Limit

Band edge emissions radiated outside of the specified frequency bands shall be attenuated by at least 50 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

2.5.2 Measuring Instruments and Setting

Refer a test equipment and calibration data table in this test report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RBW / VBW	1MHz / 1MHz for Peak, 1 MHz / 1/T for Average

2.5.3 Test Procedures

The test procedure is the same as section 2.4.3.

2.5.4 Test Setup Layout

This test setup layout is the same as that shown in section 2.4.4

2.5.5 Test Deviation

There is no deviation with the original standard.

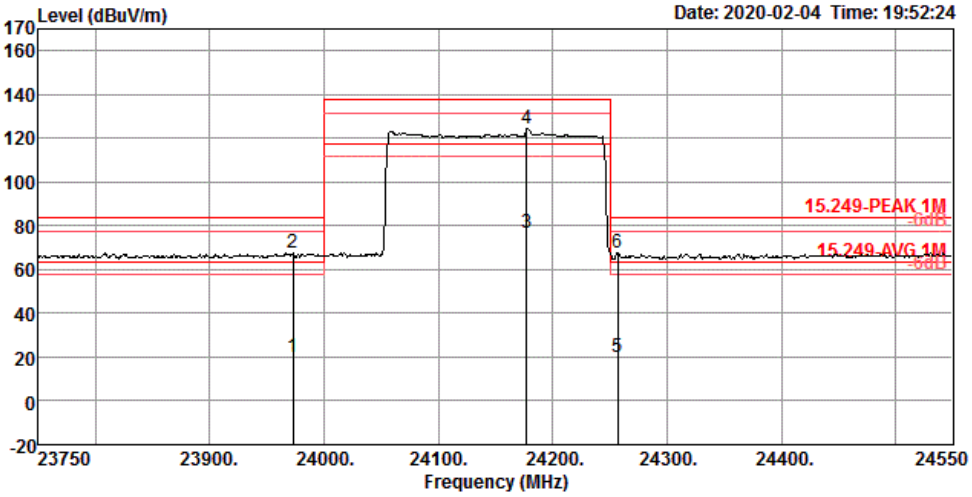
2.5.6 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

2.5.7 Test Result of Band Edge and Fundamental Emissions

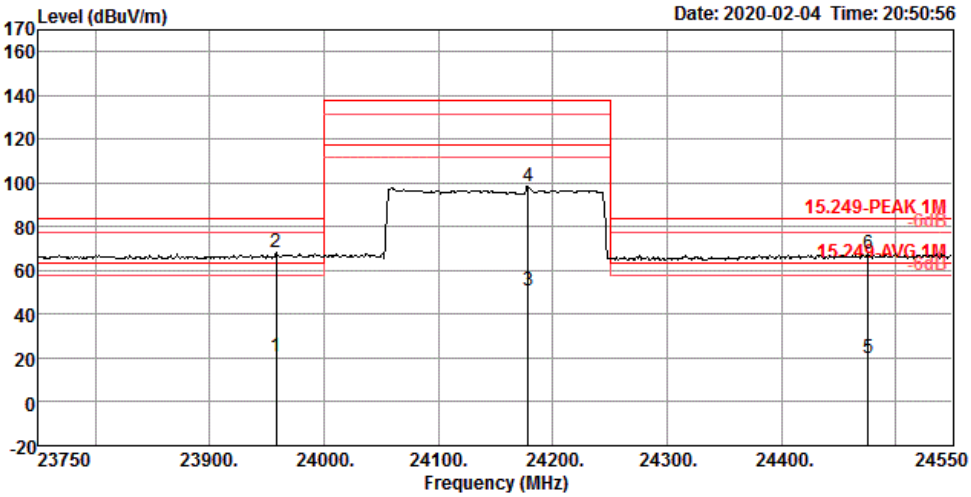
Temperature	19~20.6℃	Humidity	64~67%
Test Engineer	KJ Chang		

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	23972.40	20.20	63.54	-43.34	3.15	15.99	38.91	37.85	153	3	Average	VERTICAL
2	23972.40	67.88	83.54	-15.66	50.83	15.99	38.91	37.85	153	3	Peak	VERTICAL
3	24177.20	76.78	117.54	-40.76	59.86	16.08	38.87	38.03	153	3	Average	VERTICAL
4	24177.20	124.46	137.54	-13.08	107.54	16.08	38.87	38.03	153	3	Peak	VERTICAL
5	24257.20	20.14	63.54	-43.40	3.29	16.12	38.85	38.12	153	3	Average	VERTICAL
6	24257.20	67.84	83.54	-15.70	50.99	16.12	38.85	38.12	153	3	Peak	VERTICAL

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	23958.00	20.75	63.54	-42.79	3.65	15.99	38.92	37.81	153	10	Average	HORIZONTAL
2	23958.00	68.43	83.54	-15.11	51.33	15.99	38.92	37.81	153	10	Peak	HORIZONTAL
3	24178.80	50.62	117.54	-66.92	33.72	16.09	38.86	38.05	153	10	Average	HORIZONTAL
4	24178.80	98.30	137.54	-39.24	81.40	16.09	38.86	38.05	153	10	Peak	HORIZONTAL
5	24476.40	20.06	63.54	-43.48	3.34	16.22	38.80	38.30	153	10	Average	HORIZONTAL
6	24476.40	67.74	83.54	-15.80	51.02	16.22	38.80	38.30	153	10	Peak	HORIZONTAL

Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

2.6 Antenna Requirements

2.6.1 Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

2.6.2 Antenna Connector Construction

The antenna connector complied with the requirements.

3 List of Measuring Equipments

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Test Receiver	R&S	ESCS	100359	9kHz ~ 2.75GHz	Jul. 26, 2019	Jul. 26, 2020	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 25, 2019	Dec. 24, 2020	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127650	9kHz ~ 30MHz	Nov. 21, 2019	Nov. 20, 2020	Conduction (CO01-CB)
COND Cable	Woken	Cable	Low cable-CO01	9kHz ~ 30MHz	May 21, 2019	May 20, 2020	Conduction (CO01-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	N.C.R.	Conduction (CO01-CB)
BILOG ANTENNA with 6 dB attenuator	Schaffner & EMCI	CBL6112B & N-6-06	22021&AT-N0607	30MHz ~ 1GHz	Oct. 12, 2019	Oct. 11, 2020	Radiation (03CH04-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 29, 2019	Mar. 28, 2020	Radiation (03CH04-CB)
Pre-Amplifier	Agilent	310N	187291	0.1MHz ~ 1GHz	Mar. 20, 2019	Mar. 19, 2020	Radiation (03CH04-CB)
Spectrum Analyzer	R&S	FSP40	100142	9kHz~40GHz	Dec. 18, 2019	Dec. 17, 2020	Radiation (03CH04-CB
EMI Test Receiver	R&S	ESCS	826547/017	9kHz ~ 2.75GHz	May 15, 2019	May 14, 2020	Radiation (03CH04-CB)
RF Cable-low	Woken	RG402	Low Cable-03+22	30MHz – 1GHz	Oct. 07, 2019	Oct. 06, 2020	Radiation (03CH04-CB)
Horn Antenna	ETS-LINDGREN	3115	00075790	750MHz ~ 18GHz	Nov. 04, 2019	Nov. 03, 2020	Radiation (03CH03-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jun. 27, 2019	Jun. 26, 2020	Radiation (03CH03-CB)
Pre-Amplifier	Agilent	8449B	3008A02097	1GHz ~ 26.5GHz	Dec. 19, 2019	Dec. 18, 2020	Radiation (03CH03-CB)
Pre-Amplifier	MITEQ	TTA1840-35-HG	1864479	18GHz ~ 40GHz	Jul. 03, 2019	Jul. 02, 2020	Radiation (03CH03-CB)
Spectrum Analyzer	R&S	FSP40	100019	9kHz ~ 40GHz	Jun. 19, 2019	Jun. 18, 2020	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-20+27	1GHz ~ 18GHz	Oct. 07, 2019	Oct. 06, 2020	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-27	1GHz ~ 18GHz	Oct. 07, 2019	Oct. 06, 2020	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-40G#1	18GHz ~ 40 GHz	Jul. 24, 2019	Jul. 23, 2020	Radiation (03CH03-CB)
RF Cable-high	Woken	RG402	High Cable-40G#2	18GHz ~ 40 GHz	Jul. 24, 2019	Jul. 23, 2020	Radiation (03CH03-CB)
Mixer	OML	M19HWA	U91113-1	40 ~ 60 GHz	Oct. 01 2019	Sep. 30, 2020	Radiation (03CH03-CB)
Mixer	OML	M15HWA	V91113-1	50 ~ 75 GHz	Oct. 25 2019	Oct. 24, 2020	Radiation (03CH03-CB)
Mixer	OML	M12HWA	E91113-1	60 ~ 90 GHz	Oct. 25 2019	Oct. 24, 2020	Radiation (03CH03-CB)

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
Mixer	OML	M08HWA	F91113-1	90 ~ 140 GHz	Oct. 25 2019	Oct. 24, 2020	Radiation (03CH03-CB)
Standard Horn Antenna	Custom Microwave	M19RH	U91113-A	40 ~ 60 GHz	N.C.R	N.C.R	Radiation (03CH03-CB)
Standard Horn Antenna	Custom Microwave	M15RH	V91113-A	50 ~ 75 GHz	N.C.R	N.C.R	Radiation (03CH03-CB)
Standard Horn Antenna	Custom Microwave	M12RH	E91113-A	60 ~ 90 GHz	N.C.R	N.C.R	Radiation (03CH03-CB)
Standard Horn Antenna	Custom Microwave	M08RH	F91113-A	90 ~ 140 GHz	N.C.R	N.C.R	Radiation (03CH03-CB)
Spectrum analyzer	R&S	FSV40	100979	9kHz~40GHz	Feb. 25, 2019	Feb. 24, 2020	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-06	1 GHz – 26.5 GHz	Oct. 07, 2019	Oct. 06, 2020	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-07	1 GHz –26.5 GHz	Oct. 07, 2019	Oct. 06, 2020	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-08	1 GHz –26.5 GHz	Oct. 07, 2019	Oct. 06, 2020	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-09	1 GHz –26.5 GHz	Oct. 07, 2019	Oct. 06, 2020	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-10	1 GHz –26.5 GHz	Oct. 07, 2019	Oct. 06, 2020	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-28	1 GHz –26.5 GHz	Nov. 18, 2019	Nov. 17, 2020	Conducted (TH01-CB)
Power Sensor	Agilent	E9327A	US40442088	50MHz~18GHz	Feb. 07, 2020	Feb. 06, 2021	Conducted (TH01-CB)
Power Meter	Agilent	E4416A	GB41291199	50MHz~18GHz	Feb. 07, 2020	Feb. 06, 2021	Conducted (TH01-CB)

Note: Calibration Interval of instruments listed above is one year.

N.C.R. means Non-Calibration required.

4 Measurement Uncertainty

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	2.0 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	4.3 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	4.3 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	5.1 dB	Confidence levels of 95%
Radiated Emission (40GHz ~ 60GHz)	4.6 dB	Confidence levels of 95%
Radiated Emission (60GHz ~ 90GHz)	5.1 dB	Confidence levels of 95%
Radiated Emission (90GHz ~ 200GHz)	5.6 dB	Confidence levels of 95%
Conducted Emission	2.4 dB	Confidence levels of 95%